THE LANCET
Planetary Health

Supplementary appendix

This appendix formed part of the original submission and has been peer reviewed. We post it as supplied by the authors.

Supplement to: Ford JD, Zavaleta-Cortijo C, Ainembabazi T, et al. Interactions between climate and COVID-19. *Lancet Planet Health* 2022; **6:** e825–33.

Pathways through which climate and COVID-19 interact

Contents

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Supporting case study text boxes

In this supplementary section we illustrate the pathways through which climate and COVID-19 interact with Indigenous and other-marginalised communities using case studies from the COVID Observatories, an international research program working in nations of varying income levels to document experiences, impacts, and policy responses to COVID-19 in the context of climate risks. The COVID Observatories is collaborating with the following Indigenous peoples in Uganda (Indigenous Peoples: Batwa), Namibia (Ovambo), Ghana (Dagaaba), South Africa (Xhosa), Peru (Asháninka, Shawi), Sri Lanka (coastal-Vedda), India (Irula, Badaga, Toda, Kota, Kurumba), Fiji (iTaukei), Russia (Even), Australia (Gubbi Gubbi), and Canada (Inuit). Case studies here are drawn from seven of these regions:

Sri Lanka and Coastal Vedda communities.

In January 2022, Sri Lanka faced its fifth wave of COVID-19, with >600,000 recorded cases in total and over 15,000 deaths. Sri Lanka is an island located in the Indian Ocean that is increasingly exposed to climate change impacts, including increasing annual mean air temperature and annual rainfall variations. Based on an econometric analysis, Jain et al (1) found that humidity, PM 2.5, and wind speed affected the confirmed COVID-19 cases in Sri Lanka, while temperature, air pressure, PM 2.5 influenced associated death cases in the country. Indigenous 'Coastal-Vedda' peoples live in the rural eastern coastal belt of Sri Lanka (2), and have demonstrated resilience in-light of disruption caused by the pandemic, underpinned by high levels of local agency and leadership, Indigenous knowledge systems, and collective action. First, Coastal-Vedda communities managed challenges of reduced market access due to pandemic disruption through diversified livelihood activities including culture-based fisheries, home gardening, chena cultivation, and rice farming. Second, Coastal-Vedda self-organized to take preventive measures in the context of a lack of government interventions for COVID-19 awareness. After realizing the true extent of the pandemic (via radio and television), local leaders decided to adopt measures such as wearing masks, maintaining social-distancing, and limiting social gatherings. Third, Coastal-Vedda possess specific cultural attributes that

help them manage the pandemic, with a history of practicing their own ways of dealing with illnesses using nature-based rituals, such as connecting with the forest spirits and certain types of dancing. Such practices enhance inner confidence and boost their immune system, thereby helping them fight disease through a better frame of mind. However, COVID-19 responses have been undermined by climate-related events; for example, unexpected flooding events in January 2021 increased COVID-19 transmission in the region and increased food insecurity.

Figure 1. Home gardening at Sri Lanka.
(Credits: Eranga K. Galappaththi)

Figure 2. Road flushed-out due to extreme weather and floods in Coastal-Vedda's community in Eastern Sri Lanka.
(Credits: Eranga K. Galappaththi)

COVID-19, disrupted livelihoods, and compounding risks due to cyclones for Indigenous peoples in India

India has reported a COVID-19 death toll of 0.436 million people, the third highest in the world. While there are no official statistics on how many of these are Indigenous peoples, in the first wave, urban centres were more severely affected than rural, more remote regions, where Indigenous communities reside. However, the second wave has seen a shift in COVID incidence. For illustration, the southern state of Kerala reported that as of January 2021 around 3,000 tribals had contracted the infection, and this figure increased five-fold to about 17,401 by May 31. Of the total 8,815 Covid-related deaths in Kerala, 146 were of tribals (3).

The Nilgiri Biosphere Reserve, home to multiple Indigenous communities such as the Badigars, Irulas, and Kurumbas, and spread across three states (Tamil Nadu, Karnataka, and Kerala), has not seen very high incidence of COVID and recent state efforts to vaccinate have been promising with reports of 21,103

individuals being vaccinated at least once (of a total of 21435 eligible individuals) (4). However, vaccine hesitancy and inadequate healthcare coverage has stymied efforts to contain the pandemic.

Indigenous communities within India have been relatively shielded from the pandemic in terms of mortality, but poor access to health services and under-testing in remote locations has meant that cases might be underreported (5). There have also been direct impacts on livelihoods especially in households that migrate seasonally or cyclically to cities which have been epicentres of disease outbreak (6, 7). Ground reports showcase that Indigenous communities have used local knowledge systems, Indigenous healthcare practices, local leadership and organisation, and communal monitoring to deal with the secondary impacts of the pandemic. Those dependent on migration to cities returned to their village homes after the first wave and resorted to subsistence agriculture and use of non-forest timber products for sustenance. Such livelihood shifts have led to second-order impacts such as stricter regulations on forest use as well as isolated incidences of migrants being shunned in their communities (7). However, significant outreach by the state government, primary health workers, and local government teachers has led to more awareness on the pandemic and its nature, leading to communal efforts to contain infections and spread. Indigenous communities have also utilised traditional medicine and cultural norms to tackle COVID, practicing certain offerings to appease deities.

In other locations across the country, such as the eastern coastal states of Odisha and West Bengal, have seen a compounding of risks with cyclones and COVID intersecting. Cyclone preparedness measures meant relocation thousands of coastal communities to cyclone shelters but these reduced social distancing measures, increasing risk. Livelihoods already disrupted by COVID were further eroded by the cyclone and early estimates show tribal communities were doubly exposed to these intersecting risks (e.g. Mitra 2020 reports how Kondh communities dependent on forest produce in Odisha saw reduced incomes due to green cover destroyed by Cyclone Amphan in May 2020)

COVID-19 and wildfires in Siberia

The number of wildfires in Russia has increased rapidly over the last few decades (8). In 2020, officials registered 2061 wildfires on a total area of 6349.9 thousand hectares in Republic of Sakha (Yakutia), Northeastern Siberia (9). Wildfires caused significant damage to human livelihood and agricultural infrastructure. Nearly 2390 tons of harvested hay were destroyed in a fire in central districts of Yakutia (10). The situation has been compounded by the pandemic, which posed challenges to people. Indigenous communities living in remote rural areas have been particularly affected by both the wildfires crisis and COVID-19. Inadequate health care services and logistic difficulties increased the risks of Indigenous peoples developing COVID-19. Unlike other countries, the data on COVID-19 cases among Russian Indigenous peoples were not registered, however. Another threat is a high risk for virus spread at settlements where mining activity of industrial companies is prevalent (11). In April 2020 for example, approximately 3000 cases were officially confirmed in Gazprom's Chayanda natural gas field in the Southwestern Yakutia (12).

COVID-19 and natural disasters in Fiji

Since the WHO declared COVID-19 a global pandemic, Fiji has experienced three Tropical Cyclones (TCs) impacting over a third of the population. Located in the Pacific Ocean, this nation of 332 islands has always experienced TCs, and prior to the pandemic Fiji's greatest concerns were climate change and Non-Communicable Diseases (13). Intensifying TCs and rising sea levels have salinized freshwater resources, accelerated coastal erosion, destroyed homes and farms, forcing some villages to relocate (14-16). Meanwhile, the transition to a western diet is causing poor health, Currently, Fiji is ranked 18th in the world for the prevalence of diabetes and 24th for obesity conditions, both shown to increase the risk and severity of COVID-19 (17-19). To reduce COVID-19 transmission the Fijian government closed air and sea borders two weeks after the WHO declaration. Tourists and non-Fijian citizens including humanitarian workers were required to leave as lockdowns, curfews, and travel restrictions were imposed to prevent community transmission.

Over the next ten months three TCs struck Fiji. TC Harold (category 4) struck on 8th April 2020, then on December 17, 2020 TC Yasa (category 5), and on January 31st 2021 TC Ana (category 2). Together these events killed five people, displaced over 329,000 forcing 28,000 into evacuations centres and causing over US$350 million in damage to infrastructure, homes and livelihoods. COVID-19 restrictions delayed urgently needed disaster relief. Disaster responses in Fiji are centralized and largely managed by international humanitarian workers who had been required to leave the country when the pandemic was declared. Although permitted to return to Fiji, after TC Harold each worker had to undergo 14 - 28 days' quarantine delaying when they could resume their work. Grounded flights and closed sea borders delayed getting workers and international aid to Fiji and its distribution amongst the islands. The additional requirement for aid to be sanitized and quarantined for several hours, added a further delay to distribution. Meanwhile, travel restrictions, lockdowns and curfews prevented local aid workers from working outside their own communities. In the mass evacuation shelters families were required to maintain a two-meter distance and regular hand hygiene; however, flooding increased the risk of typhoid and leptospirosis limiting access to clean water.

Figure 3: Flooding from Tropical Cyclone Ana and COVID-19 restrictions delayed getting aid to those in need in Fiji

(Citation: Photo © Fiji Government January 2021. https://www.sott.net/article/448032-Tropical-Cyclone-Ana-leaves-1-dead-5-missing-in-Fiji-almost-14-inches-of-rain-in-24-hours)

Uganda COVID19 Response & Climate change vulnerability

The first case of COVID19 in Uganda was reported on 21 March 2020. As of 30 September 2021, the country had registered 123,857 cases and 3,159 deaths cumulatively. Amidst this pandemic, Uganda is highly vulnerable to climate change impacts that worsen public health conditions. For example, the country recently faced a number of climate extremes such as landslides, floods, and rising lake levels, among others. These, coupled with COVID-19 have made it even more difficult for the vulnerable communities to cope. Extreme rains in Kasese district in May and July 2021 triggered floods and landslides in 30 villages, displacing hundreds of people and the rising lake levels of Lake Kyoga in August 2020 submerged hundreds of acres of gardens leaving hundreds of households displaced (20). These extreme events have implications for health outcomes as they lead to increased disease outbreaks, population displacement, and disruption of the health system. Effects of climate change undermine the health system and reduce its resilience.

Since the pronouncement of the COVID-19 pandemic, Uganda and the Ministry of Health specifically was put on alert and a response plan was prepared in consideration of the International Health Regulations (2005) for countries to develop core capacities to Prevent, Protect and Provide a public health response to public health threats, while ensuring safe passage (Uganda Ministry of Health, 2020). The following response activities have been on-going aimed at reducing the impact of the pandemic:

- Coordination and leadership from national, district and community levels.
- Active surveillance, testing and contact tracing.
- Lockdowns (closing schools, universities, shops, limiting transport and movement)
- Case management in hospitals e.g. as of 30 September 2021 276 active cases were in health facilities across the country.
- Logistics and operations e.g. procurement of ICU beds, PPE and medical oxygen (see image below).
- Risk communication and health promotion – communicating to the public COVID19 standard operating procedures (SOPs) e.g. physical distancing,

hand washing and using hand sanitizers, wearing face masks, avoiding crowds and staying home.

- Vaccination – first targeting frontline workers e.g. health workers, teachers and security and eventually all the population as of 30 September 2021, a total of 1,906,039 doses of vaccine were administered.

With particular reference to Indigenous Peoples (IPs), in Uganda some IPs like the Batwa adhered to COVID-19 measures, including physical distancing, staying home and avoiding trading centres because of crowds, which challenge food and nutrition security by restricting access to markets. Extended lockdowns in Uganda especially for border districts where most IPs live hampered their movement to access forests for foraging, access to nearby communities to offer labour for food exchange, and access to agricultural fields for food production. Also the fragmented nature of cultivable lands, sometimes requiring traversing across communities to reach them meant IPs were particularly impacted by the lockdown. These challenges are exacerbated by climate change effects including floods in 2019 that damaged crops, compromised food production and reduced the resilience of IPs in the face of COVID-19 pandemic (21).

Figure 4: Medical Oxygen for managing COVID-19 patients (Photo credit: MoH,www.health.go.ug, 2021)

South Africa: COVID-19 and drought

South Africa's climate hazards and development status directly and indirectly impact on communities' vulnerability and their capacity to overcome the challenges imposed by COVID-19, such as the drought and poor infrastructure. Droughts are considered the most relevant hazard in South Africa due to its socio-economic repercussions (22, 23) and nowhere is this more evident than the Eastern Cape, a province that has been suffering from drought since 2015 (24). Although the severity of this extended drought has not been directly attributed to climate change, the dryer conditions are consistent with projections from climate models for the next 20-30 years. The conditions became so severe that on October 29th, 2019, the Premier declared a state of disaster (25). The province is thus concurrently fighting two disasters: the drought and COVID-19. The common water shortages brought by the drought affect people's abilities to adhere to one of the key preventive COVID-19 measures, regular washing. The drought also affects people's job security in the agricultural sector and their ability to maintain home gardens, which impacts people's ability to manage changing food access and availability with COVID-19 restrictions and the economic fallout of the pandemic (22, 23).

The Eastern Cape, one of the least developed provinces in South Africa, is characterized by rural areas and poor infrastructure, making its population more vulnerable to disasters in general. The province has 27.9 % of its households involved in agriculture in 2016 (26), indicating its central role in the province's food security. More than 20 years after democratic elections, South Africa still faces challenges that go beyond poor infrastructure and extend to unemployment, education, particularly for black learners, and access to public health system (27). These are more prominent in the Eastern Cape, where 12.7% of its household being multidimensionally poor and 72.9 % of the headcount in 2015 were living below the upper-bound poverty line (28). Thus, the ongoing climate disaster, together with the infrastructure and development challenges in the Eastern Cape, increases vulnerability and hampers the communities' resilience. In the 2019/2020 cropping season, the total area planted by smallholder and communal farmers was smaller than the two previous season (29). Seven municipalities in the province have over 40% of their territory under

severe or extreme drought (30).The financial loss related to livestock production alone is estimated at US$440 million. These challenges are at the forefront of people's livelihoods and take priority over the pandemic in many instances, although the province had many COVID-19 hot spots municipalities in the second (November – January) and in the third wave (June 2021 – ongoing).

Figure 5: Home garden or 'backyard' garden as the community members call it, in Joza, Makhanda, Eastern Cape.
(Credits: Nosipho Nkwinti)

Figure 6: A child waits at a community tap on a 'water on' day to collect water. (Credits: Nosipho Nkwinti)

COVID-19, flooding, and dengue in Amazonian Peru

In May 2021, Peru reported a COVID-19 death toll of 180,000 for a total population of 32.51 million. The resulting in 550 deaths per 100,000 inhabitants is the highest rate reported worldwide (31). The Amazon region has been hard hit, and is home to 13 % of poor and 14.8% extreme poor population in Peru (32) making the region highly vulnerable to emerging health risks, especially Indigenous communities where only 32% had access to health facilities within their territory (33) and only 18% had access to public water services (34). COVID-19 has occurred in parallel to the largest outbreak of Dengue, and concurring with extreme flooding events, creating a unique compound-risk challenge for the Amazon population. Since the beginning of the pandemic, multiple epidemiological alerts have been reported regarding increasing cases of Dengue, with the largest ones occurring in December 2020, and February and March 2021 (35, 36). Dengue is a climate sensitive disease that typically increases during the rainy season and with warmer temperatures; however, vector control activities have demonstrated a positive effect on reducing the transmission independently of climatic factors (37). COVID-19 restrictions have limited these preventive health activities, including elimination of breeding sites for the mosquito *Aedes aegypti and* fumigation which were stopped, putting Amazon population at a higher risk for Dengue disease during 2021(38). For Indigenous people who have limited access to good quality of health services, coexisting of dengue and COVID-19, increases their susceptibility of being misdiagnosed, not receiving appropriate treatment, and creates excessive worry. One of our community observers reported her experience with Dengue and COVID-19 in January 2021. She had to transport to the health post and then to the hospital, because initially the health worker suspected of Dengue, he took a serological test, told her to come back on 15 days to get the results. The next days she and her family got severe respiratory symptoms, and a posterior test confirmed that they all got COVID-19, the dengue test resulted negative.

“I went to the hospital, because at the health post we had to make an appointment specially for the laboratory worker to come. They told us that everything was a chaos. So, I went down from my community to the city of Satipo, because all my family was feeling bad, my mother and my father were hit very hard. And we went down to Satipo, and then with dengue, they told us; ´please we are going to have

to take a sample for dengue. But the result will be on 15 days´. Meanwhile we continue with the fever, fever and fever. From there we had to take care of each other but …well. We despaired when we began to lack of air. Because we could not even move from one place to another, because it was that, we felt very agitated, and we tried to localize the closest health post. My mother was the first to be detected, because she works in [a governmental institution]. The manager was there to help her more…. He took her to the health post, and it was the first time they detected her at the post, that she had her Covid".

Examples of actions to respond to COVID-19

Across the COVID Observatories project we have documented and examined national, regional, and community-level responses focused on maintaining the health, livelihoods, and well-being of Indigenous peoples. While this research is ongoing, here we profile selected examples of actions that have been identified by partner communities and decision makers as effective at helping manage the pandemic and which also have the potential to build resilience to climate-related risks.

Response area	Details of actions undertaken
Livelihood and food programs	- Loans to non-agricultural small businesses to alleviate financial pressures from closures and loss of revenue (Namibia) - Supporting livelihoods of Indigenous Peoples in forested regions (i.e. establishing additional Van Dhan Kendras) (India) - Acquisition and distribution of basic food products to vulnerable families, including Indigenous Peoples (Peru) - 2020 Indigenous Communities Support Fund provided funds to develop community-based solutions including support for Elders and vulnerable community members, measures to address food insecurity educational and other support for children, and emergency response services preparedness measures to prevent the spread of COVID-19 (Canada) - Distribution of free dry ration kits, and provision of financial assistance to low-income families with at least one COVID-19 patient (Sri Lanka) - Acquisition and distribution of basic food products to vulnerable families, including Indigenous Peoples (Russia) - One-time payments to all families with children, deferred taxes and rent payments, concessional lending (Russia) - Promotion of greater connection to the land through increasing local food production, including through the 'Home Gardening' program and a new 'Farm Support Package' (Fiji)
Resource management	- Water subsidies to ensure access to water (e.g. distribution points are kept open without a need for water cards) during lockdowns (Namibia) - Supporting sustainable harvesting and management of forested regions (i.e. facilitating the distribution of harvesting toolkits via network of Van Dhan Kendras) (India) - Funding made available for community hunts to gather traditional foods and for elders to cover costs of their household expenses (Canada)

Migration	- Facilitating the mobility and basic needs of communities migrating back to hometowns (i.e. migration exacerbated the demand for food and housing) (Peru) - In the remote Arctic territory of Nunavut, subsidisation of regional airlines to ensure community access (Canada)
Quarantine proceedings	- Establishing a home-based quarantine system in villages for the COVID-suspected individuals and those who arrived from other areas (Russia) - Establishing village level COVID control committees (Sri Lanka)

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